APPENDIX

TO THE

SECOND EDITION

OF THE

TANNIN PROCESS.

BY

C. RUSSELL.

LONDON:
ROBERT HARDWICKE, 192, PICCADILLY.
HENRY GREENWOOD,
(Office of THE BRITISH JOURNAL OF PHOTOGRAPHY),
2, YORK STREET, COVENT GARDEN, W.C.

Erratum in Text: Page 93, line 14, for *light* read *slight*.

APPENDIX.

SINCE the publication of the second edition, the author has discovered a very important and hitherto unknown condition of success. Some improvements in the mode of working will now be given, and some mistakes corrected; but the writer's principal object is to describe the effects of different kinds of treatment, so that every one can make his own formulæ. Great sensitiveness with good quality of pictures can now be obtained with much greater certainty than before.

The true cause being now recognised of a fault to which all processes on glass are more or less liable, and which limits the capability of rendering contrast, means of avoiding the evil with certainty will be described.

The references are to the pages of the text.

P. 11. If the old collodion contain salts which absorb moisture from the air, the rubbers will soon be made unfit for cleaning, the adhering moist matter smearing the glasses, and making it impossible to obtain a clean picture. A better cleaning liquid may be made by mixing a little ether or good benzole* with alcohol, iodine, and

* Benzole is the more powerful solvent of grease, but ether is more easily removed from pores of the glass by washing.

tripoli. Pure alcohol of ordinary strength should be used, as it does not make the liquid emit so pungent an odour as methylated spirit, which was recommended with old collodion to make it easier to clean off; good methylated ether in small proportion causes little inconvenience.

A very troublesome class of spots in negatives appears, after careful investigation, to be caused by soluble matter left in pores of the glass. They show most readily and abundantly when the collodion is very porous, but a horny film and a substratum of gelatine or India-rubber will not prevent their appearance when the plates have been much soaked or kept long; they will even find their way to the surface of long-kept collodio-albumen films. One of the worst kind, transparent with a minute dark nucleus, seems to be caused by hyposulphite: alkaline matters make dark spots, acids transparent ones. No cleaning liquid seems quite free from risk of making spots, if simply polished off; that which has just been described answers pretty well in this way, when the plates are after cleaning well dried, especially by heat, with free access of air to the surface. The safest plan is to wash and soak the plates well in water after cleaning with any effective liquid; in this way old glasses answer as well as new. As it is very difficult to dry by wiping or otherwise without leaving smears or marks, it is a good plan to rub a little tripoli over the plates with a tuft of cotton and then set up to dry; when to be used they can be cleaned in a

few seconds, if too much tripoli has not been left on them, by polishing with a felt rubber and wiping the edges. The tripoli should have been cleaned by washing on a paper filter, first with water acidified with nitric acid, and then with plenty of clean water.

In cases where any kind of impurity adheres with great tenacity, a very dilute solution of hydrofluoric acid may be used; this acts in the same manner as sulphuric acid in cleaning copper, by dissolving off a little of the glass, and so giving a new surface. The solution in water does not, like the vapour of the acid, leave a dead surface; if a drop of strong solution be left on glass until it makes a visible depression, the part affected is quite bright and does not show in a negative, whilst the partial corrosion by soda sometimes makes a difference in intensity. To clean with hydrofluoric acid, dilute one part of solution of ordinary strength with four or five parts of water, and keep in a gutta-percha bottle; drop on a cotton rubber (not on the glass), rub over the plate, and then wash well, or traces of acid left in pores will make points of insensitiveness. This plan answers well, but so strong a measure should rarely, if ever, be necessary.

P. 14. Although unnecessary and even injurious with porous bromised collodion, yet a substratum of gelatine answers well with some kinds; indeed, a horny sample containing iodide can hardly be worked without the gelatine. When this is used the bath must be neutral, or very nearly so.

P. 27. The India-rubber and amber solution should not contain too much chloroform, or the specific gravity will be too great to allow the liquid to clear by subsidence; after standing for some days it should be clear enough to be decanted and used without filtering. The liquid should be filled up as it wastes, with fresh solution of half the strength, or it will in time become too thick by evaporation. To remove particles of dust washed from the plates, the solution may be kept in a collodion filter, poured from the lip, and returned to the globe at the top. If the cotton be packed tightly enough to support the glass tube through which the displaced air escapes into the globe, the liquid will not flow through freely enough. To avoid this difficulty, fit the tube into the neck with a perforated cork, cutting channels on the outside; plain collodion smeared over the whole of the cork will prevent dust from being washed out of it. The cork should not fill the neck to the top, that a ring of cotton wool may be packed lightly round the tube; when the cotton is clogged it can easily be removed and replaced by fresh, without disturbing cork or tube. A cylindrical cap of paper, fitting loosely over the apparatus when not in use, and reaching below the lip, will prevent the adhesion of dust.

P. 28. It is better to sweep the India-rubber lightly with a soft camel's-hair brush than with a velvet rubber; the former removes dust better, and is less likely to injure the film. This brush should not be

used to dust glasses after cleaning with tripoli. Brushing the India-rubber with anything which cuts it may allow the collodion to penetrate behind and form clots which appear towards the end of draining off the collodion.

The collodion, especially if thin and containing much ether, will sometimes partially dissolve the India-rubber and pass underneath it, forming a lump or ridge, which shows as a mark of insensitiveness. To prevent this it is usually sufficient, in coating the first few plates, to move the bottle so as not to pour all on one place; should any difficulty still be found, however, it is easy to saturate the collodion with India-rubber. This may be done in many ways: a very effective one is to pour into a dry bottle, or one which has held ether, a little of a strong solution of India-rubber, with or without amber, in chloroform (such a solution may conveniently be kept ready for dilution with benzole). The liquid is to be flowed all over the inside of the bottle, and dried by turning slowly round uncorked before a fire, until it no longer smells of chloroform; the lining of India-rubber will quickly saturate collodion kept in the bottle.

P. 32. A very small proportion of iodide will work well with a large quantity of bromide. [See below.]

P. 35. The quantity of water in Mr. Glover's formula should be about doubled when the best American cotton is used.

P. 37. If no iodide of ammonium is used in the

collodion, bromide of ammonium may, if necessary to make it flow well, be partially or entirely substituted for bromide of cadmium. Diminishing the salts will lessen the tendency to over-iodise the bath, but make the film less opaque, unless more pyroxyline be used; this again will impair adhesion to the glass. Alcohol s. g. ·810 may be used for both plain collodion and iodising solution. When the alkaline developer is to be used, it is better to salt the collodion exclusively or nearly so with bromide. [See below.]

P. 38. The method of working with bromised collodion had not been in use long enough before it was published to admit of its being sufficiently tested; for a considerable time all went well, but it afterwards became evident that some condition of success was unknown. Bromide behaves in the exciting bath differently from iodide; the latter comes out to meet the nitrate of silver, forming on the surface of the film a layer composed chiefly of iodide of silver, and leaving a substratum of collodion containing but little iodide. Bromide, on the contrary, is converted where it lies, more uniformly through the thickness of the film as far as the nitrate penetrates, and it requires a long immersion in a strong bath to convert the whole. It also takes a long time to remove unconverted salt from the back of the film by washing, especially when the collodion contains much pyroxyline and is at all horny.

At first the only difficulty met with was that of re-

moving the soluble bromide sufficiently to obtain full sensitiveness, and, therefore, it being supposed that all the salt should be converted, a little more water and less pyroxyline were used in the collodion to facilitate this; the plates were also often left to soak in water for a great length of time. The result was, with occasional exceptions, more or less fogging, the tendency to which varied much without apparent reason. The usual remedies, such as a new bath, more acid in it, &c., entirely failed to correct the evil; and, after a very long investigation, it was found that the tendency to fog depended entirely on the duration of the exciting and washing. It was impossible any longer to avoid the conclusion that bromide of silver is discoloured by a developer without being acted on by light, when no trace of a soluble haloid salt is in contact with it; further experiments confirmed this view beyond all possibility of doubt. In this way one of the principal causes of uncertainty in dry photography is removed, and, by the light thrown on the subject, it is easy to explain some curious differences of opinion and practice.

This discovery made it necessary to test over again the effects of various modes of treatment, and carefully to examine the behaviour of iodide and bromide of silver, and of the soluble iodides and bromides. The most important results of the investigation were—That washing off the tannin gives a real increase of sensitiveness, which is not due to the more complete removal of soluble salt; that it is not advantageous to develope

bromide of silver with pyrogallic acid and nitrate of silver; that the alkaline developer has little if any developing power on iodide of silver; that when each is treated throughout in the manner best suited to it, bromide of silver alone is about eighteen times more sensitive than iodide of silver alone; that iodide of silver, as far as this was tested, did not appear to require the presence of a soluble salt. In these experiments the nitrate of silver was chemically removed from the films by soluble bromide or long soaking in common water before applying the tannin, and a pure collodion was used, which, being simply washed and dried without nitrate of silver or tannin, would scarcely give a trace of an image after an exposure which was sufficient when tannin was used.

The result of the examination of the action of soluble iodides and bromides was that the former were not only much more energetic, but that their effect was more permanent. Bromide of silver plates, soaked in a liquid containing forty grains to the ounce of a soluble bromide, were easily restored to full sensitiveness by washing and treating with tannin, while, with the same treatment in other respects, the substitution for the bromide of one-tenth grain to the ounce of a soluble iodide made the film comparatively insensitive, and the image weak and foggy. Increasing the iodide aggravated these evils till one-half grain or more to the ounce made the plates almost entirely insensitive, and incapable of even fogging to any extent. In these

experiments the plates were not exposed to light during the preparation.

Notwithstanding the bad effects of too much soluble iodide, the presence of a very slight trace of it seems to be advantageous, as it helps to prevent fog, and makes it difficult to produce it by over-washing. Other advantages appear to be gained in this way; for instance, $\frac{1}{800}$ grain to $\frac{1}{400}$ grain of iodide to the ounce of developing liquid actually stimulates development and favours intensity on plates which would just keep clear of fog without the iodide; whether this has any advantage over bromide used in the same manner, however, is not yet clearly made out, nor whether the soluble iodide can be entirely substituted for bromide. The writer has not as yet been able to work satisfactorily in this way, but the investigation is beset with many difficulties.

At one time it seemed as if a small proportion of iodide of silver was useful, for one grain of iodide with twelve grains or fifteen grains of bromide in the collodion made it easier to obtain the proper combination of sensitiveness with brightness and vigour; eventually, however, it was found by many courses of experiments that the good effect was entirely due to a trace of unconverted iodide. In trying the effects of small proportions of iodide in the collodion, a very curious result was obtained. Sixteen grains of bromide of cadmium were dissolved in ten drachms of collodion; another portion of the same collodion contained fifteen

grains of bromide of cadmium and one grain of iodide of cadmium; in other portions one grain more of iodide of cadmium was successively substituted in each for one grain of bromide of cadmium. A plate was coated with each, and all were treated in the manner best suited to the bromide alone. It was found that one grain of iodide slightly diminished sensitiveness and increased brightness and intensity a little; the collodion containing two grains of iodide was as sensitive but less intense than that salted with bromide alone, and further substitution of iodide for bromide decreased intensity more and more without affecting sensitiveness. The same thing occurred in two or three sets of plates, but the effect seemed so strange that it was thought that some mistake might have been made in preparing the samples of collodion. Accordingly, fresh portions were prepared and tried, with precisely the same result as before. The only way in which the phenomenon can be explained seems to be this:—when the proportion of iodide is very small, a trace of it remains unaltered with the unconverted bromide; when in larger proportion, the iodide is all converted by a strong bath.

The results of the whole investigation left no room to doubt that iodide of silver with a large proportion of bromide of silver, when the treatment is that best suited to the latter, is totally inert, and serves no useful purpose except to aid in preventing the passage of light through the film. Even without practical proof

this might be expected to be the case; for, not only is the iodide many times less sensitive than the bromide, and is made still more inert by the soluble salt which is necessary to keep the bromide from fogging, but it is, even when well exposed, nearly or quite unaffected by the alkaline developer, which will only produce a very faint trace of an image on simply iodised pure collodion, so faint as to be scarcely visible by transmitted light. This slight effect may probably be produced on some other combination of silver in the collodion and not on the iodide. Plates prepared with iodide alone, when the development was commenced with the alkaline developer, were inferior in every respect to those which were treated with a silver developer from the first. Simply iodised collodion, to produce a tolerably good negative, was found to require an exposure long enough to give a visible image of the sky before development; this is not the case with collodion containing bromide. These facts may indicate that the iodide of silver is insensitive because no known developer suits it when chemically freed from nitrate of silver and treated with tannin.

Besides the great sensitiveness of bromide of silver, it has other valuable properties. It resists solarisation to an extraordinary degree. From its behaviour in the nitrate bath, already described, it follows that a sufficiently large proportion of bromide may be used in the collodion to make it porous and non-contractile, and in this way it is easy to prevent all liability of the film to

split when dried after washing off the tannin, as well as the tendency to expand and leave the plate when moistened again;* consequently, any tolerably good soluble cotton can be used, and thus some of the greatest difficulties in dry photography are avoided. Another result is that no loose layer of bromide of silver is formed on the surface of the collodion; even when the proportion of bromide is very large, the film is quite bright when dried, and can be brushed with cotton without making marks. This is not the case when much iodide is used.

The proportions of pyroxyline and bromide in the collodion may be varied considerably without affecting the result much, if the conditions are understood and the treatment suitable. The larger the proportion of pyroxyline, the farther must the exciting or washing be carried to produce sensitiveness, and the more contractile will the film be, but the less the liability to fogging and spots. Decreasing the proportion of pyroxyline facilitates the conversion and washing out of soluble salt, and renders the film non-contractile, but makes it easier to produce fog by carrying the exciting or washing too far, and allows very slight traces of noxious soluble matter under the film to form spots.

The formula at p. 41 will, perhaps, give as good results as any other with suitable treatment, but the

* A porous film containing a large proportion of bromide is, however, tender, especially before being dried. It is therefore desirable, though not necessary, to use a substratum of India-rubber, which enables the film to bear rough handling at the edges, and also tends to conceal slight impurities on the glass. The India-rubber is very easily applied, and saves trouble on the whole.

proportion of bromide may be increased. The quantity may be from ten to fifteen grains to the ounce; alcohol s. g. ·810 is quite strong enough. The best methylated ether answers perfectly well. Methylated alcohol might probably be used, perhaps with advantage, were it prepared by some method which would ensure sufficient purity from fusel oil. The best proportions of pyroxyline and bromide, and the best kinds of bromide, depend a good deal on the quality of the pyroxyline. A sample which does not make the collodion flow well, sets very quickly, and gives a horny film, should be used in small proportion, or if not in very small proportion, as much bromide of ammonium as will dissolve (about three grains or four grains to the ounce), should be partially substituted for bromide of cadmium.

Cotton which makes a limpid collodion, and gives a porous film deficient in setting power, must be used in larger proportion, and be salted with bromide of cadmium exclusively. A medium kind of soluble cotton, neither horny nor powdery, is on the whole the best. That made by the formula at p. 35 or at p. 40, or a mixture of the two, will answer well; any kind may be used which in the way just described can be made to combine flowing and setting qualities sufficiently. As a general rule the bromide should not be less than twice, nor more than five times, the weight of the cotton, which may be from two grains to five or six grains to the ounce, according to its quality and other

circumstances. Except as regards solubility in alcohol, and effect on the physical condition of the collodion, it matters little what kind of bromide is used.

To make the collodion, put cotton, salt, and alcohol into the bottle; shake till the salt is dissolved, then add the ether; the cotton will dissolve quickly without adhering to the bottle. If pyroxyline be not at hand, any ordinary plain collodion which sets firmly and answers well in the wet process may be used. To three drachms add two drachms ether, three drachms alcohol, and ten grains bromide of cadmium. If this do not work well, alter the proportions as indicated by the rules laid down above.

P. 41. Bromine in the collodion is not now recommended; it has too great a tendency to make the collodion gelatinise.

P. 43. When the exciting bath contains much nitric acid, frequent treatment with carbonate of silver would increase the quantity of nitrate of silver in solution rapidly; so in this case it is better to keep the bath in the acid state, and when out of order, or occasionally after long use, to make it alkaline with ammonia, and sun. The accumulation of nitrate of ammonia does no harm, for a bath purposely prepared with a very large quantity of this salt worked as well as one free from it. Mr. Dawson has discovered that alcohol precipitates bromide of silver from its solution with nitrate of silver. This is not the case with iodide of silver; and perhaps the new fact may indicate that

alcohol in quantity is harmless or even useful in a bath and with bromide only, but this has not yet been tested. A bath in pretty constant use may be left for a considerable time in the trough, covered with paper to keep out dust; in this way the ether escapes readily, but alcohol still accumulates.

The strength of the bath required for bromised collodion depends on the thickness of the film* and on the quantity of bromide in it: it is not necessary to saturate with bromide of silver. To make an opaque film, the bath should not contain less than sixty grains of nitrate of silver to the ounce; it may be much stronger if required. It should be freely acidified with nitric acid (one drop of strong acid to each ounce will not be too much). This facilitates the conversion of the bromide, and, after complete removal from the film by washing well in common water which contains a trace of a carbonate, it neither affects sensitiveness nor the clearness of the image. This last depends on the amount of unconverted salt present, and if enough to prevent fog is to be left in the film, it is important that the action of the nitrate of silver be not carried too far.

To ensure every plate being excited equally, it is a good plan to have an open watch, paper, and pencil close by, and put down the time of dipping each plate. The best time to keep in the bath is commonly about ten minutes, but of course this depends on circum-

* The same collodion will, of course, unless diluted, make a thicker film on a large than on a small glass; this must be taken into account in the treatment throughout.

stances. It may easily be known in any particular case how long it takes for the nitrate to penetrate to the glass, by looking from time to time during the excitement through the film, which is never quite uniform in thickness; but the nitrate, penetrating all over at the same rate, or nearly so, causes a pretty uniform opacity until its action begins to reach the glass, when it produces a peculiar clouded appearance of unequal opacity. The first appearance of this does not show that the whole of the salt is converted, for opacity begins whilst the soluble bromide is still greatly in excess of the nitrate. The clouded appearance, however, indicates that the influence of the nitrate begins to make itself felt quite at the back of the film, and it is usually better to stop short of this.

Many months of investigation failed to lead to any certain method of ensuring the presence of exactly the best quantity of soluble salt. Removing the whole of this, and using a known quantity in a final wash or in the developer does not answer well; for, not only is it difficult to remove the salt entirely, and almost impossible to know with certainty when it is all removed, but the application to the surface of salt enough to prevent fog below greatly diminishes sensitiveness. If the proper duration of exciting and washing are once found out by trial, it is not difficult, with the same bath and collodion, to produce plates in very nearly the best possible state.

As has been already stated, a very small quantity of

iodide in the collodion, not exceeding one grain to the ounce, makes the quality of the plates less dependent on the time of washing. Even this small quantity of iodide may in time deteriorate the strong bath (this has not been properly tested) but nearly the same good effects may be produced by dipping in a very dilute solution of iodide after the complete removal of the nitrate of silver from the film; or, if a pretty strong solution of bromide be used to remove the last traces of nitrate, the iodide may be dissolved in the same liquid. The strength of iodide may be from $\frac{1}{800}$ grain to $\frac{1}{100}$ grain to the ounce. Another plan which has been found to answer, is to use the small trace of iodide in the tannin solution and all washing waters after the removal of the nitrate. Small fractions of a grain of any soluble matter are easily obtained by dissolving in a measured quantity of water; for instance, if one grain be dissolved in 500 minims, every five minims of the solution contains $\frac{1}{100}$ grain.

P. 41. The irregular marks in the direction of the dip, seen only by transmitted light, and gelatinous lumps, which look as if pushed out from below the film, and which cause pinholes, can be avoided by making the bath stronger or the collodion thinner, or by diminishing the quantity of bromide in it. The immediate cause of the streaks and lumps is not known. Another way of avoiding the latter is to remove the plates sooner from the bath, but this diminishes opacity and makes more washing necessary.

The lumps are probably not caused by crystallisation of nitro-bromide of silver; for they are quite as apt to appear with a fresh plain solution of nitrate of silver, if too weak, as in an old bath.

Another fault is sometimes caused during excitement, but is not visible until the negative is finished, when the more transparent parts have a granulated appearance something like ground glass; the surface appears to have been disintegrated, probably by the formation of minute crystals of nitro-bromide of silver. To avoid this annoyance let the collodion set well and firmly; if it will not do so without drying too much at the edges, dissolve in the same sample a little more cotton of a quicker setting kind, and in making a fresh quantity use bromide of cadmium in it exclusively.

P. 46. To avoid waste of nitrate of silver, after exciting dip the plates successively in three baths of distilled water* (1, 2, and 3). This plan also saves distilled water, for it may be used for a great number of plates before changing. Then pour the contents of (1) into a glass or earthenware vessel, fill (1) from (2), (2) from (3), and (3) with fresh water. The water set aside should be made alkaline with ammonia, and can at any time be filtered into a large porcelain dish, kept in a dry place in the light, covered with muslin stretched on a frame a little larger than the dish, to keep out dust and insects. When the liquid has become strong enough by evaporation, it may be again filtered, acidified, and restored

* Distilled water does not appear to be absolutely necessary, except in this part of the process, but it is well also to use it as a final wash.

to the bath. In this way scarcely any nitrate is expended, however strong the bath, except that which is actually decomposed in forming the bromide of silver in the film. A fourth bath may contain a solution of a soluble bromide to remove the last traces of nitrate of silver. The bromide seems to have some advantages over common salt. One of these is that it appears to be less apt to form smears of adhering insoluble salts on the surface of the film. (This has not been accurately tested.)

The old mistaken idea that the presence of nitrate of silver is necessary to sensitiveness has done much to retard the progress of dry photography. To support this notion another equally unfounded theory had to be started:—That it is impossible or difficult to remove all traces of free nitrate of silver from the film. Now, under all ordinary circumstances, if the collodion contain bromide, much of this remains unconverted after excitement. When the film is washed in common water the nitrate is quickly removed and decomposed; not only so, but the unconverted bromide below usually has to be washed out in great part through the surface before full sensitiveness can be obtained. This state of things is, of course, quite incompatible with the presence of any trace of free nitrate of silver.

The time required to remove by washing all the nitrate, depends on the depth to which it has penetrated and on the nature of the film, so, to save time and make sure, it is always best to dip in a bath of bromide.

The strength of this is of little consequence, as salt thus introduced is easily removed again, but from two grains to five grains to the ounce will be sufficient. It is not worth while to use a large quantity only to have the trouble of getting rid of it again. It matters little what bromide is used: bromide of potassium answers as well as any. Most samples of this salt contain a trace of iodide of potassium as an impurity. This will answer the same purpose as the addition of a trace of iodide to a pure bromide; but if very impure in this way it is evident, from what has already been said, that the bromide must be used in much smaller quantity than if pure. To avoid some trouble in finding out the proper strength of the solution, it is well to get the bromide where it can be depended on as being nearly pure, and it is still more important to keep as much as possible to the same sample. Weak solutions of bromide sometimes become mouldy: a drop of nitric acid in several ounces will prevent this.

Collodion containing a large proportion of bromide makes a film which is porous all through, and soluble impurities in or under it are apt to spread like ink on blotting paper, and so make large spots. A dilute solution of albumen has on the film, even after being thoroughly washed off again, much the same effect that size has on paper, making the spots much smaller, especially when the plates are not kept very long. The writer's attention was called to this fact by the late Mr. Glover, who mixed albumen with the tannin solution

just before using it. The result of some trials in this way, and of a somewhat similar experiment previously made—that of applying the albumen after the tannin—showed that in this way the albumen diminished sensitiveness and intensity.

If the albumen be applied before the tannin it still acts as a size, but its other effects are very different. The albumen now seems to form some combination which requires more, and, so to say, neutralises the soluble salt, too much of which commonly remains in the film, and thus makes it easier to obtain sensitiveness. This, under the most favourable circumstances in each case, is about the same, with or without the albumen. When albumen is thus used, at least twice as much salt as would otherwise be required is necessary, and enough to prevent fog cannot always be kept in the film without removing from the exciting bath before the proper opacity is produced. It is therefore advisable to dissolve some bromide, with or without a trace of iodide, with the albumen, which, by making the film closer, prevents the too easy removal of the salt by washing.

In this way of working the quality of the plates is almost entirely independent of the duration of the exciting and previous washing, the albumen and salt correcting both ways. The albumen always retards development and diminishes intensity a little, but, as it makes the colour of the image more non-actinic, probably the same amount of development gives about the

same printing power, with or without a weak solution of albumen. Not more than five minims of albumen to one ounce of water (one part to ninety-six) should be used, or the retarding effect will be too great. The albumen solution may contain from $\frac{1}{800}$ grain to $\frac{1}{100}$ grain of iodide of potassium, and from two to thirty grains of bromide of potassium, according to the quantity of unconverted salt already in the film, and the amount of washing to be given afterwards. The liquid should be in contact with the film for about five minutes, and may either be used in a dipping bath or be poured on the plate on a stand.

The effect of the albumen does not depend on any combination made by it with nitrate of silver, and, when much bromide is dissolved with the albumen, it makes no difference whether a previous bath of bromide be used or not; in this case the albumen solution may be used in the fourth washing bath instead of the plain bromide. If the albumen wash contain little or no salt, before applying it, the last traces of nitrate of silver should be removed by bromide, or smears may be formed on the film. The albumen liquid should be kept in a bottle with a very little carbolic acid, essence of lemons, or oil of cloves, to prevent mould, and should be carefully filtered before use. A few drops of carbolic acid beat up with several ounces of white of egg will keep it in good order for a great length of time. Albumen prepared in this way is semi-opaque, but when diluted for use answers well and requires no

further addition to keep it. Undissolved portions of carbolic acid, however, when it is used in quantity, and when the liquid is not well filtered, have been suspected of forming dark spots on the negatives (?).

Before applying the tannin the albumen is to be well washed off. The best way of doing this uniformly and so as to make all the plates alike in quality, is to dip each the same number of times in a bath of common water, changed for every plate. If fog appear on developing, use more bromide with the albumen or wash less If the plates are insensitive, but the image very bright, do the contrary. A few trials will show the treatment which suits any given collodion and bath. The use of albumen is not necessary, but it seems on the whole that the advantages gained are sufficient to repay the little extra trouble which it gives. The albumen by its own direct effect, and by enabling us to use a larger proportion of bromide in the collodion than would otherwise work well, makes it easier to combine great sensitiveness with certainty, and it gives something of the character of an albumen picture to the finished negative. Slight errors in the quantity of salt left in the film can be corrected in the development in a manner which will be described. This is much facilitated by preparing all the plates in the same batch as much alike as possible.

The law that bromide of silver fogs in the absence of a soluble haloid salt, appears to hold good with all developers and in every collodion process, except, per-

haps, when acid is present in so large a quantity as greatly to reduce sensitiveness. As iodide of silver alone is very insensitive when freed from nitrate, it would appear that, in the present state of our knowledge, sensitive dry plates cannot be produced by any process without, knowingly or otherwise, complying with the condition of keeping a proper amount, and no more, of soluble salt in the film. The degree of accuracy necessary varies with the nature of the film. In the wet process it is a matter of common observation that bromo-iodised collodion kept too long in the exciting bath gives a flat and foggy picture. In this case, however, it matters little, except so far as it affects the opacity of the film, how far the nitrate penetrates, so long as some unaltered salt remains below. However large the quantity of this, the great excess of nitrate of silver on the surface is sure to keep it sensitive.

Ordinary bromo-iodised collodion, except that it should be excited in a thirty-grain or forty-grain bath, may be used for dry plates, in all other respects, in the manner now recommended for bromised collodion; and the quality of the plates is less affected by slight variations in the extent to which the exciting and washing are carried, for the back of the film, which holds the unconverted salt, being close in texture, holds it so obstinately that it is not easy to wash it out to too great an extent. On the other hand, the same condition of the film, when, as is commonly the case, too much soluble salt remains, makes it come out

so slowly during development that it does no very great harm. These advantages are obtained at the cost of greatly reduced sensitiveness and intensity compared with those obtainable with bromised collodion. The albumen wash answers well with bromo-iodised collodion; sufficient density will scarcely be produced unless by intensifying with nitrate of silver. As has been already stated, if a substratum of gelatine be used, the bath must be neutral, or very nearly so.

The addition of seven grains of bromide of cadmium to one ounce of common bromo-iodised collodion has been tried, and also the addition of eighteen grains of bromide of cadmium to one ounce of the same collodion diluted to two ounces with ether and alcohol. Both samples were treated throughout in the same manner as bromised collodion, and gave, except in intensity, nearly as good results; but the trial was not carried far enough to test whether, as seems probable, so much iodide would soon spoil the strong bath.

P. 53. Tannin has been said to be a sensitiser, and this seems really to be the case. Collodion, which will scarcely give a trace of an image when simply washed and dried, will produce a good negative when tannin is applied after drying the film but before exposure, while the application of tannin after exposure has scarcely any effect. Albumen used in the way already described (and probably many other organic matters), will sensitise bromide of silver, though much more feebly than tannin; but when the albumen is applied with or after

the tannin, all effect in forming a combination which sensitises, and neutralises soluble salt, is prevented by the superior energy of the tannin.

P. 55. The tannin may be dissolved in the water and alcohol in a bottle, but should not be used until it has settled perfectly clear; how long this will take depends on the purity of the tannin. No practical inconvenience seems to be caused by resin in the clear solution, which filters readily. If the tannin be dried on the film without having had time enough to penetrate properly, markings will be produced, which, when the film is dry, may be seen by their greater opacity where there has been least penetration.

P. 61. It is better not to wash off the tannin in a dish, particularly a gutta-percha one, unless it be thoroughly cleansed immediately after use, as a muddy sediment is afterwards formed which is difficult to remove, and the slightest trace of this remaining will cause smears on the next lot of plates washed in the same dish. To avoid this evil the following method, which is quite as easy, may be adopted:—Pour the tannin on and off a few times, and return to the bottle or measure; then lay down on a stand or otherwise horizontally; when five or six plates have been thus treated, wash off the first, and so on. The removal of the tannin is facilitated by pouring a little water on each plate a few minutes before its turn to be washed.

The extent to which the washing is carried does not, so far as the completeness of the removal of the tannin

is concerned, make much difference; but all the plates in each batch, especially when the collodion is very porous, should be washed as nearly as possible alike, to avoid leaving a varying amount of salt in the films. With good manipulation it matters little how the washing is performed: it may be done under a stream of water, or by pouring on, waving about, and pouring off. If the washing, however, be not performed uniformly over the film, the corners are apt to be insensitive or the centres to be foggy. The best way to ensure uniformity is to dip each plate the same number of times in a dipping bath, as recommended for removing the albumen liquid. Common water may be used: it should be changed for every plate. The bath should be of glass, and should be cleaned with nitric acid, or anything which will effectually remove organic matter, immediately after use. The washing of the plates should be finished by rinsing with distilled water. To avoid touching the edges towards the end of the operation, put on a holder, and to save water pour a little on and wave about well; the last portion especially should be well flowed about all over the surface, or poured on and off, to avoid imperfect mixture of liquids, or unequal distribution of soluble matter, which would be sure to cause marks.

P. 63. The plates should be set up to drain in such a manner that the water may leave them freely; for if it stagnates near the lowest corner till it evaporates away, that corner is sure to be insensitive from accu-

mulation of soluble salt. To ensure free draining, set up the plates either on a pad of blotting paper many times doubled, or, which is more economical, on a strip doubled a few times, and reaching outwards far enough to hang down over the edge of the draining stand two or three inches. A drop of water stagnating between the peg or other support and the edge of the glass, will often form a small mark of insensitiveness. This may be prevented by placing a small piece of blotting paper between the support and the glass, or on the back of the glass at the place of contact. The writer finds it the best plan to allow the plates to drain dry spontaneously in a moderately cool place, without disturbing or moving them. If much warmth be used, and particularly if the rate of drying be altered by taking up the glasses and setting down again, or by moving the stand into a hot place when the plates are half dry, marks are pretty sure to be formed.

P. 64. The writer has prepared tannin plates which gave good results after being kept for two years, part of the time in an uninhabited house. In a letter from Mr. Valentine to THE BRITISH JOURNAL OF PHOTOGRAPHY, 9th Sept., 1864, it is mentioned that some plates prepared with old bromo-iodised collodion, the tannin being washed off as recommended in the 2nd edition, were taken from Dundee to San Francisco round Cape Horn in a grooved deal box, which was kept in a damp place. The plates after the voyage were very sensitive and gave good pictures.

It appears that after exposure the impression of light fades very slowly, as was long ago stated by Dr. Hill Norris to be the case with his plates. An experiment made carefully to test the matter accurately, seemed to show that, if to be kept a month, the plates should be exposed at least half as long again as if to be developed at once. The plates which had been kept appeared as if less exposed, but otherwise gave as good an image as if developed immediately. Drying the tannin on the film did not prevent the fading, as a plate so treated still appeared less sensitive than one from which the tannin had been washed.

P. 66. For dusting plates before putting into the slides, the best way is to make a Buckle's brush by drawing a tuft of cotton wool into a goose quill with a doubled string, so as to leave the ends of the fibres of cotton free; the ends of the string tied together will make a loop to hang it up by.

P. 69. It is better to mix some acid with the pyro-gallic acid solution as well as with the silver. When strong solution of the former is used, especially in hot weather, it is difficult to keep the developer clear without this. Acetic or formic acid may be used; the quantity should be varied according to circumstances.

P. 74. Mr. Bartholomew introduced the valuable improvement of using alcohol in the moistening water.

P. 75. When the alcohol and water is returned to the bottle, if the plate be drained closely and laid on a levelling stand for from four to ten minutes, the deve-

loper will flow freely on the film. It may be known when the alcohol has evaporated sufficiently by the appearance of the surface. This should look level and free from oily prominences, but the edges must not be allowed to dry. If the developer be poured on before it will flow freely, the plate, especially if fully exposed, is pretty sure to show clouds of unequal intensity. If several plates are to be developed at the same time, the first will be ready for the developer by the time they have all been moistened and drained, so no time need be lost. The same liquid should not be used for plates on which the tannin has been dried and those from which it has been washed. It is no longer necessary to regulate intensity by altering the strength of the tannin solution, nor to keep this low to avoid blurring. [See below.] Fifteen or twenty grains of tannin to the ounce, or more if preferred, may always be used.

P. 80. The fault which has been called "blurring," to which all processes in which glass is used are more or less liable (unless the non-actinic sensitive film be behind the glass and in optical contact with it), has been one of the greatest banes of photography, not only by its direct effects, but indirectly, by driving photographers into the wretched system of taking views with the sun straight behind the camera, and by compelling them to give insufficient exposures with subjects containing violent contrast of light and shade. Means have been already described whereby the evil in

question could be avoided to a great extent, but the writer did not know how these acted, nor whether the mischief was caused optically or chemically, until a statement of Mr. Sutton's explained the real cause, which is—light which has passed through the over-exposed parts of the film being reflected forward in a greatly diffused state.

After verifying the truth of this theory beyond all possibility of doubt, the writer was surprised to find that Mr. Marlow had explained the matter in an able paper read at a meeting of the London Photographic Society in April, 1861. The unreasonable opposition and incredulity with which Mr. Marlow's statement was received, in spite of the plainest proofs, are difficult to understand, and unfortunately deprived photographers of the knowledge of an important fact for some years.

Similar films differently prepared vary much in their power of stopping light. Tannin dried on the film, gum, gelatine, and similar substances facilitate the transmission of light; but a course of experiments showed that films to which tannin had been applied and washed off again stopped light as well or better than any others originally of similar opacity, wet or dry, except Fothergill plates, which have a slight advantage in this respect. The dense films which, contrary to common notions on the subject, can be produced with bromide of silver, tend also to prevent the evil. The liability to blurring depends a good deal on the depth to which the image is developed,

for a superficial image is not affected by reflected light until it has passed a second time through the film. Now, a superficial image is usually poor and feeble, and it is impossible to produce a film of collodion, consistently with other necessary conditions, opaque enough to stop all light under some circumstances; it is, therefore, desirable to take measures to absorb any light which may pass through. Yellow glass does this very effectively, but involves the necessity of transferring the film. Velvet, or dry paper of a non-actinic colour, pressed against the back of the plate, will absorb that portion of the light which passes through the glass, and so prevent reflection from the back of the slide, which causes what is called "fogging from over-exposure," but will not prevent the more local effect called "blurring," which is caused by internal reflection from the back surface of the glass. To prevent this, the easiest way with dry plates is to paint the back with water colour, mixed with gum or dextrine, and a little glycerine or treacle to prevent its drying too much and separating from the glass, with which it must be in optical contact.

Care should be taken that the back of the glass be not greasy. The paint should be as stiff as will spread well, and should be laid on with a broad brush. The plates may be painted while draining on the stand, when the edges have become dry, care being taken not to disturb the plates; the paint will be dry sooner than the film.

Any paint which does not reflect actinic light in a diffused state will answer. Gamboge is rather too light in colour, but for that reason, and from its transparency, it is pleasant to use, when left on during development. Raw and burnt sienna answer well, except that they are rather opaque; a little of either or both mixed with gamboge will make it more effective. Red ochre reflects dark red light, which is very harmless, and transmits it of a nearly neutral tint: it is very opaque. Orange chrome and orange lead are not only opaque but ineffective, probably because they are mixed with white lead or whiting. The best colour tried was the orange yellow colouring matter of anatto, prepared from the cakes by cutting in slices, boiling, subsidence, decantation, and evaporation; the insoluble matter, which appears to be yellow ochre, is opaque and almost useless. The paste which is sometimes sold as anatto seems to be coloured principally with red ochre, and, like it, is effective but opaque.

If the paint is to be left on during development it should be transparent and not too dark; when dry, the corner from which the developer is to be poured should be protected by applying a thick solution of India-rubber with a brush. After fixing, the whole of the paint can be removed with the greatest ease by putting the plate in a dish of water for a few minutes, and then rubbing with the fingers. A pleasanter and, perhaps, on the whole, quite as easy a way of working, is, before developing to hold the plate upright on a piece of wood,

and to shave off the paint with a sharp, broad, thin chisel, using it like a plane, at a small angle with the glass. If both sides are alternately applied to glass which is smooth and free from grit, the edge will not be blunted for a long time. In this way it of course does not matter how dark the paint is, or how thickly and unequally it is laid on (perhaps it would be best to use a scarlet colour deep enough to look nearly black); the India-rubber is not required, and the paint can be used again.

The painting does not give much trouble, and, unlike any operation on the film, involves no risk of failure, whilst the advantages gained are so great that they would be well worth the trouble, were this ten times as great; this can easily be proved by painting half a plate, and exposing fully with a subject giving great contrast. The writer never intends to expose a dry plate again without painting it, and can recommend the same course to others. A dry tannin plate thus protected will bear turning towards the sun far better than a wet plate unprotected: the exposure may be several times as long for the shadows as would otherwise be admissible, without bad effect. The writer has in this way taken the sun's disc in a cloudless sky on a tannin plate without solarisation or rings (which are caused by reflected light), the exposure being long enough to render water and vessels.

Mr. Dawson found that thick red blotting paper saturated with water and applied to the back of the

glass would prevent blurring on wet plates. Whatever means of absorbing transmitted light be adopted, it is necessary to exclude air, the thinnest film of which between the glass and the absorbing matter will cause reflection, as may be verified by examining the reflection of the flame of a candle from a glass variously backed in different parts. Any tolerably opaque matter kept in optical contact by something of nearly the same refracting power as glass, will prevent the formation of a secondary definite image from the back surface, but the diffused light reflected from the absorbing matter should be non-actinic; white paper would not answer so well photographically as red, yellow, or black. The back surface should be in such a state that it would give as little impression as possible were a picture taken of it in the camera.

To obtain the full benefit of the paint care should be taken to cut off all light, as far as possible, which is not actually employed in forming the image. The paint enables us to expose for a long time without bad effect from transmitted light, and in this way may make us liable to injury from light reflected from the sides of the camera, which would not be felt in a short exposure. The use of one or more diaphragms inside the camera to cut off all light which falls outside the picture, always beneficial, is now rendered still more important.

So strong is prejudice, and so great the *vis inertiæ* in such things, that it will probably take some time before

the increase in the capabilities of photography, made possible by the recognition of the reflection theory, will be fully taken advantage of. Absorbing transmitted light has other good effects besides preventing blurring. The light appears to begin to pass through an ordinary film a little before it has produced its maximum effect. After this the film is acted on at both sides, and very rapidly attains its utmost capability of darkening, and passes into solarisation. When transmitted light is absorbed, the lights bearing longer exposure without solarisation, greater contrast can be represented—greater, in fact, than can be rendered in a paper print. We want an improvement in printing to make fully available this advance in negatives. However great the contrast which the opacity of a film makes it capable of rendering, it will render still greater contrast when transmitted light is absorbed. The comparative immuniiy of wet plates from blurring does not depend on their opacity to chemical light, which, as has been observed, is not greater than that of washed tannin plates, but on the fact that the back part of the film is commonly opaque but insensitive, from the imperfect conversion of salt in the collodion. The image is comparatively superficial, and the back part, in fact, acts only as paint to stop light.

P. 84. It would be a great mistake to suppose that ammonia is a developer, except in the same sense that nitrate of silver is one. The action of ammonia and other alkalies mixed with pyrogallic acid and similar matters

greatly resembles that of nitrate of silver. Bicarbonate of soda has been recommended by some as better than ammonia. It is not very easy to determine whether it is so or not, for the soda requires the presence of more soluble salt, and therefore plates in the best state for one are not suited to the other. In the writer's hands the soda has proved less manageable than ammonia. From not knowing all the conditions, the writer formerly made a mistake in recommending the ammonia to be poured on the film alone before mixing with the pyrogallic acid. This treatment makes necessary a longer exposure than is required when the developer is mixed before being applied, even when the tannin has been dried on, and acts as a feeble developer with the ammonia. Ammonia alone has a tendency to diminish the impression of light, and makes the image, when brought out by the mixture, bright but comparatively under-exposed. It is a curious fact that bicarbonate of soda, applied alone at first, has, on the contrary, a powerful effect in causing fog with the mixed developer.

The result of the examination into the effects of the soluble iodides and bromides seemed to show that their office is to restrain the alkaline developer in much the same way that acid acts in a silver developer.

The best form of ammonia seems to be the common carbonate (sesquicarbonate); it may conveniently be kept in solution of thirty-two grains to the ounce in a stoppered bottle. One grain to the ounce is a good

strength to begin the development with as a general rule. Alcohol appears to moderate the action of the alkali, which will produce the same effect when in a weaker solution in water alone.

To correct errors in the preparation of the plates, if the first shows by fogging that too little salt has been left in the film, some must be used in the developer. If too much be present (which is known by the image coming out slowly and faintly, the film keeping very clean, and the developer discolouring very slowly), the thirty-two grain solution of carbonate of ammonia may be added until the detail is brought out, or the verge of fogging approached. If the developer be right, but the plate too much under-exposed, the liquid colours pretty quickly, and the high lights come out strongly without detail in the shadows; the addition of more ammonia in such a case will probably cause fog, but as the negative would be worthless in any way, not much harm will be done by trying it.

When too little soluble salt has been left in the film, if the deficiency be slight, the image comes out feebly, and the general appearance in the early stage is much the same as if the salt were in excess. The fogging is not very easily detected until too late, and, therefore, the first plate, in such a case, will be likely to be spoiled; from this it is evident that it is better to have too much than too little salt in the film. Any great deficiency or excess of salt is unfavourable to sensitiveness, even when the error is corrected in the development.

One of the most important recent improvements is a method of intensifying without nitrate of silver. When the detail is out, following the analogy of the silver developer, strong solution of carbonate of ammonia, containing soluble bromide enough to prevent fog, may be added to the developer. With a dense film in a suitable state, more than enough intensity may be easily and quickly obtained; when more salt than is necessary has been left in the film, the addition of ammonia to bring out detail will often, at the same time, produce sufficient intensity. To intensify without nitrate of silver, it is necessary that fogging to any extent should not have commenced, and that the layer of sensitive bromide of silver should be sufficiently thick. It is evident that if the film be translucent, it will not be very opaque when blackened all through, for the image is formed, not by depositing silver, but by reducing the bromide of silver to the metallic state, as has been proved by experiment.

This state of things is really a great advantage, for all "piling up," which often occurs when silver is used to intensify, to so injurious an extent, is entirely avoided. Three grains of bromide of potassium (any soluble bromide which does not, like bromide of cadmium, make a turbid solution with carbonate of ammonia, may be used) in one ounce of the thirty-two grain solution of carbonate of ammonia, will make a very good intensifier, and it may be used to develope when much diluted, instead of the plain carbonate of ammonia solution, when soluble

salt enough has not been left in the film, or when this is in the proper condition, after a longer exposure. This is a good plan when great vigour and brightness are more important than sensitiveness. Using more or less bromide in the developer is the best way yet devised of regulating intensity; in this way we are able, when time of exposure is not an object, to obtain great vigour under almost any circumstances, such as a very dull light. In this way also plates prepared for instantaneous pictures will answer as well as others for any kind of subject.

P. 86. The plates should be moistened before developing, in the manner already described for the silver developer (Ap. pp. 31, 32); as in that case, if the developer be poured on too soon, clouds of unequal intensity will appear. If the operation be properly performed, alcohol is not necessary in the developer. If, however, the mixed liquid contain sufficient alcohol to make it flow, it may be poured on the dry film; provided that the developer covers the surface quickly and uuiformly, it seems to make no difference whether the film be previously moistened or not. The conclusion the writer formerly came to on the subject (p. 88) was one of the mistakes made from ignorance of some of the conditions.

When the liquid has been poured on and off a few times, rinse the measure before using it for another plate; if the quantity of salt left in the films be such that a little more ammonia is required in the develo-

per, several plates (say six, if small) may be moistened one after another, and set to work without loss of time; the development will proceed to a certain point and then almost stop, with the films perfectly clear and bright, and the liquid very faintly coloured. A drop of the thirty-two grain ammonia solution may now be mixed in a measure with the developer of each, and more if required; the detail will start out quickly. When out enough, or when symptoms of approaching fog appear, add the intensifier, a drop or a few drops at a time to each as it is ready for it, until intense enough. If, on account of incipient fog or otherwise, there should be any difficulty in obtaining sufficient intensity, the film may be washed, and a fresh mixture of a little of the intensifier and pyrogallic solution applied.

As with all developers, to get the most from a barely sufficient exposure, the development must be pushed to the verge of fogging—in this case by adding ammonia if necessary. On the addition of ammonia till the liquid becomes strongly coloured, if it neither brings the high lights out strongly, nor has any tendency to sully the purity of the parts least acted on by light, a great deal too much salt has been left in the film. In such a case wash the film well with distilled water, and apply a fresh developer, as recommended by Mr. Sayce.

It will be found convenient, when developing, to have the plain thirty-two grain ammonia solution, the in-

tensifier, and a three-grain solution of bromide of potassium, at hand in dropping bottles; a drop or two of the last-named solution (which may be stronger for large plates) will, if applied in time, often save a negative which has just begun to show a tendency to fog.

It will be seen that there is a close analogy throughout between the silver developer and the alkaline one; as with the former a trace of acid is necessary in the film, some is required in the developer, and more in the intensifier, whether the same liquid be used or not, so with the latter a soluble salt must be employed in much the same way. The analogy goes so far that direct positives with pure whites of metallic silver can be produced by the alkaline method without nitrate of silver; enough soluble bromide must be used to prevent the slightest trace of fog. Only one or two experiments have been tried in this way; from these it seemed probable that the positives might be produced, as with a silver developer, after shorter exposure than that required for negatives.

It is not yet determined exactly how much of the soluble salt should be in the film, and how much, if any, in the developer, to give the greatest possible sensitiveness; but the difference is not great within pretty wide limits, if the proportion of ammonia to salt be altogether as large as can be used without causing fog. The strength of ammonia required is determined by the amount of salt. If too much of the former be present, and the liquid be left long at rest on the plate,

besides the liability to fog, mottled markings, so commonly produced by silver developers, sometimes show themselves; never in any other case, so far as the writer's experience goes (p. 89). When the proportion of bromide in the collodion is large, the film will bear almost any amount of ammonia without being loosened; ordinary bromo-iodised collodion will not bear much.

P. 88. If a negative developed with the ammonia mixture is to be intensified with silver (this is the best way when the film is contractile or deficient in opacity), a drop or two of the alkaline developer may generally be added to the developer when the detail is out; after this the silver will have less to do. Before using the silver intensifier, a few drops of acetic acid in the washing water, as recommended by the late Mr. Glover, will save time and trouble in removing the ammonia. Probably a little soluble bromide in the water may also be advantageous.

The silver intensifier often produces one form of what is by some called "halation"—that is, a very narrow dark line on the edge of the sky where it joins dark objects. When the dark band at the edge of a solarised sky is a quarter of an inch or more in breadth, it seems likely that it is produced by an easily-explained effect of reflected light; but the very narrow line appears to be caused by the greater abundance of nitrate in that part. This is the commonly-received explanation, and in this case is probably the correct one, as the writer has never seen the narrow line produced by the

alkaline developer or intensifier, except, when the sky is solarised, along the edges of trees in motion from the wind. This effect is easily explained.

Plates prepared and developed as now described are very sensitive, and work with great certainty. The writer has only tried their sensitiveness once against that of ordinary bromo-iodised wet collodion developed with iron: on that occasion the dry plate beat the wet one. Very little can of course be deduced from our experiment, but the writer's general impression is that the sensitiveness of the dry plates is greater than that of wet collodion developed with pyrogallic acid, and that it will not be found very easy to beat them with iron-developed wet plates. More care is necessarily required in preparing the dry plates than the wet ones, as the former are more apt to show spots from impurities below the film, and their quality is far more affected by the quantity of unconverted salt remaining, if the same developer be always used. On the other hand, the writer is inclined to think that the conditions necessary to sensitiveness are now better made out in the case of dry plates than in that of wet ones, so that, when the proper conditions are observed, great sensitiveness is obtained with more certainty with dry than with wet plates. The highest degree of sensitiveness attainable with the latter seems to depend on unknown conditions; the artists most successful in instantaneous work often find that they can only succeed with a new bath. The bromide of silver and tannin

plates, admitting of the use of a bath containing a large quantity of nitric acid, which is afterwards completely washed out, will work quite as well in an old bath as in a new one.

P. 90, Note. Increasing the quantity of salt in the paper, up to a certain point, increases the capability of bronzing, provided the strength of the nitrate of silver solution be proportionately increased, otherwise the opposite effect will be produced.

P. 97. One of the results of the experiment here described was not mentioned, because it was not understood at the time. Both the bromide of silver and the mixture of iodide and bromide not only darkened where they had been exposed to light, but also in a less degree where they had been shaded; this was fogging in the absence of a soluble salt. Almost everything since found out was foreshadowed in this experiment; only one discrepancy with practical results appeared. The mixture of iodide and bromide of silver became much darker than the bromide alone, while in collodion iodide of silver has no such effect. The probable explanation is that the salt necessary to keep the bromide from fogging keeps the iodide inert; it also certainly favours the blackening of the bromide. Besides this, in the experiment the silver salts were not treated with tannin, and the presence or absence of a trace of silver combined with the collodion might make a slight difference.

P. 122. Bromide of silver being much less soluble

in nitrate of silver solution than iodide of silver, the bromide does not so readily form crystals which will injure the film. Crystals of nitro-bromide of silver are, however, formed in the bath, by simply bromised collodion ; when these are of small size they make the liquid look slightly turbid. [See above, Ap., p. 20].

P. 131. A few experiments have been made with various soluble matters in very weak solution as a final application to washed tannin plates, with a view to enable the film to resume its porous condition better, when moistened for development. Gelatine, gum, and glycerine were tried in this way, but did not appear to give any advantage ; collodion made porous by a large proportion of bromide in it, and treated with a strong solution of tannin, developes so readily that no soluble matter is required in the film. In many experiments with glycerine, the best effect in the writer's hands has been that it sometimes did no harm : its usual effect was to cause fog. The effects of albumen have been described. [Ap., pp. 22-25, 27, 28].

The same principles on which the sensitiveness of tannin plates depends, apply to all dry processes, and point out the means of obtaining considerable sensitiveness with any of them; but in the method now described, everything suits everything else so well, that the writer does not know of any other plan which promises so many advantages on the whole.

It has been objected to the tannin process that too many precautions are necessary; the writer believes

that this objection is unfounded, as every precaution recommended, or something similar to it, is required with nearly all dry processes. It is not a very sensible plan to ignore causes of failure, and trust to chance to avoid them. The most simple methods too often depend on ill-understood conditions, which are more difficult to comply with than anything in the tannin method, which is more independent of the state of the collodion than any other process, wet or dry.

Some suggestions may be made of things not yet established, but which seem promising. One is to mix castor oil with the collodion: one drop to the ounce has a good effect—probably more might be used. This addition makes the film more elastic, and less liable to loosen or split. These qualities would probably enable us to use a thicker substratum of India-rubber, and more pyroxyline in the collodion, and in both ways diminish the liability to spots, which is the only real difficulty in the method now described. The only doubt about the castor oil is whether it will injure the bath; it does not appear to do so, but the plan has not been sufficiently tested to determine this question.

Another thing which the writer has tried promises to make the preparation of dry plates easier, and their quality more uniform; having, however, been much engaged with comparative experiments, in which every plate had to be differently prepared, he has not properly worked out the plan. This is to make or line a box with waterproof material, having grooves bevelled at

one side to prevent their tearing the films. This grooving may be made of ebonite, in such a manner that the plates cannot reach to the bottom of the box, where there should be a tap of glass, ebonite, or gutta-percha. After being excited, each plate is to be put into distilled water in the box; all the operations can be performed on a number of plates at the same time in the box, which must be well cleaned immediately after being used.

Carbonate of ammonia has a slight solvent effect on bromide of silver; to prevent this action the latter has been dissolved in the thirty-two grain solution of the former, which is kept in the dark room. The liquid works well, but no difference has been perceived whether the bromide of silver was used or not.

When plates are set up to drain on blotting paper, dust is apt to float, ascend on to the film, and adhere to it, making small transparent spots on the negative near the corner on which the glass was drained. Perhaps the best way to avoid this will be to moisten and squeeze nearly dry small pieces of calico, and place on the paper, turning up one side of the calico, so as to prevent contact between the glass and the paper and pegs.

P.S.—When the deficiency of soluble salt in the film is great, a much larger proportion of bromide than that given above (Ap., p. 41) will be required in the developer, and still more in the intensifier. In the former, the alkaline liquid should be much diluted.

INDEX

TO TANNIN PROCESS, SECOND EDITION, AND APPENDIX.